# DEGENERATION OF THE PERIPHERAL NERVES IN LOCOMOTOR ATAXIA.

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THE opportunity having been given me to examine some of the peripheral nerves in a case of locomotor ataxia, I believe a presentation of the specimens may be of interest to the society.

It appears that Türck was the first to investigate into the condition of the peripheral nerves in locomotor ataxia. In 1858 he examined the nerves of the skin in two cases (Dejerine), but found no alterations. This may have been owing to the then imperfect methods of examination. In 1863 Frederich found alterations in the peripheral nerves in some cases in which he examined the sciatic, crural, and radial (Dejerine). In 1868 Vulpian, in a study of the sensitive nerves, the spinal ganglia, and the sympathetic in sclerosis of the posterior columns, found no change in the cutaneous nerves.

Westphal, in 1878, in the study of a case of combined sclerosis (posterior and lateral columns), in which the sciatic, tibial, and posterior cutaneous nerves were examined, found atrophy of the nerve fibres, increase of the connective tissue, and it is especially noted that in the specimens the axis cylinders can be seen devoid of myeline; these nerves were examined only after hardening, staining with carmine, and on sections.

In 1880 Pierret (Thesis of Robin) says that, in cases of locomotor ataxia in which there are lightning pains, anæsthesia, and pemphigoid eruptions, if the terminal expansions of the nerves supplying these parts be examined, a neuritis will be discovered comparable to that of optic neuritis.

In 1883 Dejerine reported two cases of locomotor ataxia; in both were found the changes in the posterior columns; the posterior roots were atrophied. Examination of the cutaneous nerves in both cases showed alterations which he considers to be like those found after section of nerves.

In 1883 Pitres and Vaillard report a case of locomotor ataxia with œdema of the left lower extremity, arthropathy of the left knee. Microscopic examination of the peripheral nerves showed the right sciatic to be normal, while the left sciatic presented evidences of alterations similar to those found in the Wallerian degeneration.

In 1884 Sakaky reports a case of tabes from the clinic of Professor Westphal, in which some of the peripheral nerves were examined and marked atrophy of the nerve tubes found. This study was made on sections.

In 1886 Pitres and Vaillard report five new cases, in all of which changes were found in the peripheral nerves. The nerves examined were the sciatic, anterior and posterior tibial, etc.

My own case, in which the spinal cord and some of the peripheral nerves have been examined, I believe is the first case reported in this country, and, although the clinical history is imperfect, the interest attaching to the changes in the peripheral nerves justify me in presenting it to you.

A man, forty-seven years old, was seen by me six years ago; examination showed him to be suffering from typical locomotor ataxia. The notes dictated to the house physician of the hospital at that time have been mislaid. In December, 1886, I saw this patient for the second time, and made a rapid examination of him. His ataxia is extreme, he throws his legs about wildly in attempting to walk; he cannot stand without being supported on each side; muscular power is good; the tendon reflex is absent; the pupils are quite small, and do not react to light or accommodation; he has extravagant ideas; mentally he is weak, memory very poor.

A history is obtained from his sister at this time. He has always been temperate; his mother, a nephew, a maternal cousin, and an aunt are insane. His first symptoms began nine years ago; he had sharp pains in his legs and knees, and when he walked his legs "locked together;" he soon began to have pains in his abdomen, and spells of vomiting (gastric crisis); he became very irritable. Six years ago he went to the hospital, where I saw him the first time; the ataxia was extreme then. In October, 1885, he had a number of convulsions. In April, 1886, she first noticed that his mind was affected, he appeared to be absent-minded; and by August he was quite childish. In November he had some more convulsions, and developed extravagant ideas, thought he had plenty of money, and was about to marry the queen of England, etc. At present is demented, memory quite poor; thinks he is pregnant.

He becomes gradually more demented, and noisy at night. Insists upon saying he is pregnant. Is growing more and more feeble.

April 3, 1887.—During the night he had an attack of hæmaturia, passing about a pint of blood; he becomes very feeble and comatose. A large discolored patch is observed in left inguinal region. The bleeding from penis ceases, and he appeared somewhat improved at night; but on the morning of April 4th he had two epileptiform seizures, becomes comatose, and dies early on the morning of April 5th. An autopsy was made on the afternoon of the same day. The body is emaciated; there is a very extensive ecchymosis over the left lower half of the abdomen and some slight oozing of blood from the penis. Section through the abdominal muscles shows that under the discolored spot they are infiltrated with blood; all the muscles bleed freely when cut into; there is no evidence of injury. The bladder contains a large quantity of bloody fluid. The intestines are all more or less discolored, of a darkish brown. The right kidney is much congested; the capsule tears off easily; one of the calicis at the lower part of the kidney has projecting from it clots of blood, while the others present no similar condition; the pelvis of kidney contains a small quantity of slightly bloody fluid; sections through the organ showed extravazations of blood in several places in its substance. From this kidney evidently came the hæmorrhage which had occurred a day or two before and continued somewhat ever since. The left kidney was only congested. The lungs were the seat of hypostatic congestion, otherwise healthy. The heart is flabby and the aorta contains atheromatous plates.

Portions of the peripheral nerves were removed from the right leg, placed in osmic acid, and other pieces in bichromate potass. solution. The cord was also removed and placed in solution of bicromate potass.

The spinal cord shows the usual gray degeneration of the posterior columns. The portions of nerve examined are taken from the sciatic, popliteal, and external plantar. Of those pieces placed in osmic acid, the first thing observed was that they were stained by the osmic acid with great difficulty, and this lead to their being kept in the solution a longer time than is usual; even then it was found, on teasing them, that there were portions of the nerve which had not taken the black color usual in this method of preparation. The changes observed can be found in the sciatic, popliteal, and plantar; it is more extensive, however, in the popliteal and plantar; the number of healthy tubes is less great than in the sciatic.

The preparations are stained in carmine and mounted in glycerine. In every preparation made very few normal tubes are to be seen; the degree of change varies very much in the different tubes; many tubes can be found in each specimen presenting the condition of myeline which is observed after section of nerves; that is, the breaking up of the myeline into more or less irregular pieces, scattered about in the sheath, and in various stages of disintegration. Some stained very black with the osmic acid, and presenting a dense, compact appearance; other pieces only stained lightly brown, and presenting a granular appearance. In another portion of the tube may be found a still more advanced process, where the myeline is completely broken up into a fine granular mass, hardly stained by the osmic acid, and the tube is smaller. A still further process may be seen in the complete absorption of this granular myeline and shrinking of the sheath. There is commonly observed in the preparation entire nerve tubes presenting this light, granular appearance, and which has hardly been stained, if at all, by the osmic acid; not a complete block of well-stained myeline is to be seen in the tube, and this explains the lack of black staining which the nerve tubes present at various places; the change has been so great in that portion of the bundle that there is no myeline to stain. In those portions of the nerve where the myeline has undergone this extensive change, the sheath appears to have taken up the carmine a little more freely than it usually does; and when a large number of fibres together has undergone this process, they present the deep carmine stain, which is in marked contrast with the adjacent portions of the fibre which are stained more or less strongly black by the osmic acid.

Very frequently portions of a fibre or fibres appear to have undergone such rapid change in its myeline that the sheath appears to be filled with a granular-looking mass which must have been more or less liquid. The process of liquefaction was too rapid for absorption, and collapse of the sheath to occur, so that the tube appears to have nearly its normal dimensions. The interannular nucleus, with its protoplasm, appears not to have taken any active part in this process of disintegration of the myeline, as they are not enlarged, in this differing from that found after section of nerves. The nucleus is sharply stained by the carmine. In all the preparations there are to be observed numerous rolled-up, collapsed sheaths of Schwann. With a high power one can observe the vestige of myeline drops as fine granules in some of these shrunken sheaths.

In many of the tubes this change in the myeline can be observed beginning at each end of an interannular constriction, near the constriction of Ranvier, while the intermediate portions are apparently normal. Numerous tubes can be seen in which these changes in the myeline occupy only a portion of the tube, so that the parts above and below it are apparently normal.

In these tubes in which the myeline has been absorbed there appears to be an increase in the number and size of the nuclei in the sheath of Schwann. A peculiarity of this process is the persistence of the axis-cylinder. In those fibres in which the myeline is broken up into blocks, I have been unable to discover the persistence of the axis-cylinder, but these fibres are not as numerous as those which present the granular myeline alone; in these fibres the persistence of the axis-cylinder is shown beautifully, as it is stained sharply with the carmine, and can be clearly seen, especially in those fibres which have undergone that process which I have considered as a rapid liquefaction of the myeline. Often the axis-cylinder can be seen pushed to one side by this fluid, so that it rests against the sheath. I have not observed any change in the axis-cylinder.

Many tubes are to be seen, which, I suppose, are tubes in process of regeneration, at least they have been so described by writers on this subject; they are small fibres with a narrow, dark-stained band of myeline. I have not observed any axis-cylinder in them.

If sections are examined after hardening in bichromate potass., and mounted after staining with carmine in Canada balsam, a great many nerve tubes are found atrophied in each bundle. The changes are not made out as clearly, however, on sections as they are in preparations stained with osmic acid, carmine, and teased.

The condition observed in these nerves, and which I have described, does not correspond exactly to that given by most writers on the changes in the peripheral nerves in locomotor ataxia, many of them stating that it is like the changes observed in the Wallerian degeneration. The changes observed in these nerves which I present to you are, it appears to me, a different process from that observed in the Wallerian degeneration. The absence of increase in the interannular nucleus, the persistence of the axis-cylinder, the appearance of changes in certain portions of the nerve, while that portion above and below remains comparatively healthy. The greater number of tubes in which the myeline undergoes evidently a rapid granular liquefaction rather than breaking up into blocks, are all points of marked difference in the two processes.

There can be seen in these specimens, nerve tubes of considerable length, in which the changes appear exactly like those in the Wallerian degeneration, that is, as far as the myeline is concerned. The interannular, nucleus however, does not present the marked increase in size that is so common after section of nerves. The fibres presenting this appearance are, however, not nearly so numerous as those with the very fine granular myeline and the persistent axis-cylinder.

The condition here is similar to that which has been described by Gombault in 1880, in an article on Parenchymatous Neuritis or Segmentary Periaxillary Neuritis. The observations were made on the sciatic of fowls which had been slowly poisoned with lead. He especially calls attention to the persistence of the axis-cylinder, the segmentary nature of the neuritis, and the difference in the process from that found in the Wallerian degeneration.

Since that time Pitres and Vaillard, in 1886, in an article on the Alterations of Nerves in Diphtheritic Paralysis, have recognized the condition described by Gombault. Still they do not agree fully with his description. They admit the segmentary nature of the neuritis, but deny the persistence of the axis-cylinder. This peculiar change of the myeline in segments was observed by Gombault in the peripheral nerves of man suffering from various conditions, such as protopathic muscular atrophy, lateral amyotrophic sclerosis, traumatic neuritis, and diphtheritic paralysis.

In 1882 P. Meyer observed the same condition in a case of diphtheritic paralysis. The presence of these two kinds of disease fibres in the specimens, the one having the blocks of myeline scattered through it and the other with only a fine granular, liquid-looking contents, have been observed by Gombault, Meyer, Pitres and Vaillard, and myself, in all the specimens examined. The beginning of the change in the myeline near the construction of Ranvier has also been pointed out by each observer. Gombault lays considerable stress upon this; in my own specimens it can be observed if carefully looked for.

In view of the presence of these apparently different processes in the same nerve bundle, one asks is this a peculiar form of neuritis parenchymatous in origin, or is it a process similar to that found in nerves after section. I would not venture any positive statement from an examination of one case, but it appears to me that the process is quite a different one from that observed in nerves after section. I look upon it as a parenchymatous neuritis, the expression of a more or less general degenerative change in the entire nervous system, a kind of slow breaking up of the organism.

Gombault and Pitres and Vaillard have taken opposite sides on this question. Gombault looking upon it as a special form of neuritis quite distinct from the Wallerian degeneration and to explain the presence of these fibres with the large blocks of myeline in them which are so characteristic of the Wallerian degeneration, he assumes that at some point above where this segmentary neuritis has been going on the nerve fibre has been entirely cut off by the extensiveness of the process, the other portion of the fibre then degenerates, following the course of that found in the Wallerian change.

Pitres and Vaillard look upon the changes as one and the same thing, and the difference in appearance is due to the various stages of the process.

The view advanced by Gombault is ingenious, and appears to me the most likely to be correct.

These peculiar changes in the peripheral nerves which I have been describing, have not, as far as I know, been observed in cases of locomotor ataxia by any one but myself; it is a change which is evidently not peculiar to cases of posterior spinal sclerosis, as it has been seen by others in a variety of conditions, especially in the cases of diphtheritic paralysis and the experimental production of it by Gombault, which has been previously alluded to, and it is very probable that further studies may show it to be present in a large number of the changes occurring in peripheral nerves.

Fig 1

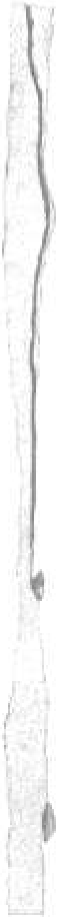


Fig 2

Fig 3

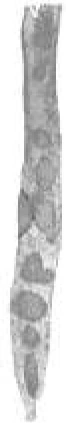


Fig 5

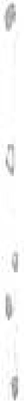


Fig 4

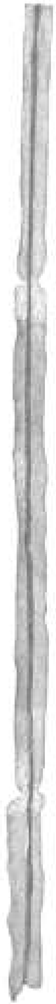
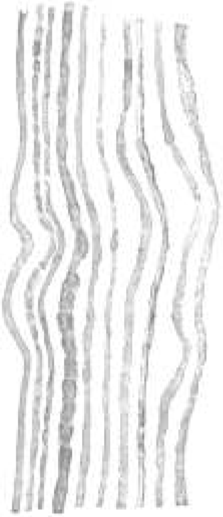


Fig 6



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## EXPLANATION OF PLATE.

FIG. 1.—Nerve fibre which has undergone rapid granular disintegration with persistence of the axis cylinder and which is pushed to one side.

FIG. 2.—Tube in which the myeline has disappeared, leaving the axis cylinder sharply stained by the carmine.

FIG. 3.—Nerve tube, showing the typical changes as seen in the Wallerian degeneration, the myeline broken up into blocks and floating about in the more granular myeline.

FIG. 4.—Fibre, showing the beginning change in the myeline at each end of an interannular segment persistence of the axis cylinder.

FIG. 5.—Tube in which the myeline has entirely disappeared, the sheath of Schwann has collapsed, and an increase in the nuclei of the sheath.

FIG. 6.—Showing a small portion of a bundle of fibres with nerve tubes in various stages of degeneration.